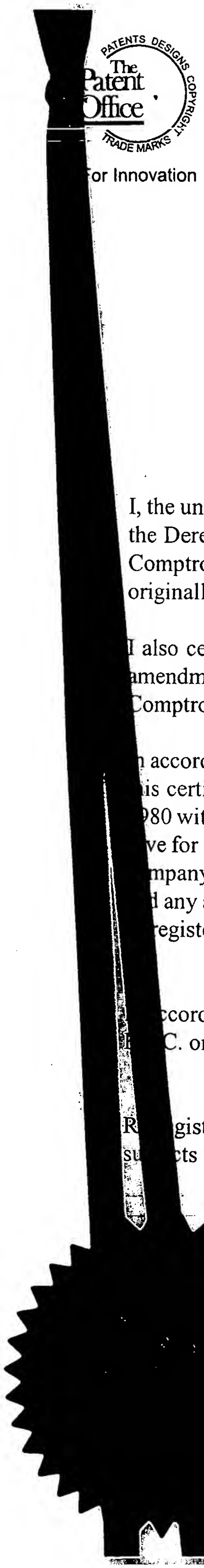

John TAYOLOR
PRODUCTION OF HYDROCARBON FUEL
May 22, 2006
Alan J. Kasper 202-293-7060
Q95094
i of i

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so registered.

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CERTIFIED COPY OF
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Signed Andrew Gerry

Dated 13 September 2006

Patents Form 1/77

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P01/7700 0.00-0327178.0

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

THE PATENT OFFICE
J
21 NOV 2003
LONDON

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

TAYLOR 01

2. Patent application number
(The Patent Office will fill in this part)

21 NOV 2003 0327178.0

3. Full name, address and postcode of the or of each applicant (underline all surnames)

TAYLOR, JOHN
20 CEDAR GROVE
AMERSHAM
BUCKS, HP7 9BJ

08759151001
Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

PRODUCTION OF HYDROCARBON FUEL

5. Name of your agent (if you have one)

Hillgate Patent Services
No.6 Aztec Row
Berners Road
Islington
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N1 0PW

Page White + Farrer
54 Doughty St
London
WC1N 2LS

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

51/77
19/5/6
Pm.

Patents ADP number (if you know it)

05953112002
1255003

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of filing (day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.

See note (d))

NO

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	—
Description	7
Claim(s)	2
Abstract	—
Drawing(s)	2 + 6

10. If you are also filing any of the following, state how many against each item.

Priority documents	—
Translations of priority documents	—
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	—
Request for a preliminary examination and search (Patents Form 9/77)	1
Request for a substantive examination (Patents Form 10/77)	—
Any other documents (please specify)	—

11. I/We request the grant of a patent on the basis of this application.

Signature(s) Hillgate Patent Services Date 21/11/03

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom PAUL HARMAN 020 7704 9997

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

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f) Part 7 should only be completed when a divisional application is being made under section 15(4), or when an application is being made under section 8(3), 12(6) or 37(4) following an entitlement dispute. By completing part 7 you are requesting that this application takes the same filing date as an earlier UK application. If you want the new application to have the same priority date(s) as the earlier UK application, you should also complete part 6 with the priority details.

DUPLICATE

Production of hydrocarbon fuel

This invention is directed towards the art of converting animal-by-product fats to a useable fuel source.

Animal fats and greases retain a high potential energy. They have historically been used as animal and human feedstuffs and as a raw fuel in process industries. However, specific health risks and legislation associated with collecting, storing, transporting, and general handling of animal by products has led to a ban in their use except for limited and licensed applications.

Although prior art provides for the limited processing of animal fats into other products, there remains a need for improvement within the art to convert animal fats to a high quality liquid energy fuel having a known and repeatable specification.

It is an object of this invention to provide an apparatus and process for the low temperature, ambient pressure cracking of animal fats into a gas oil product.

It is yet another object of this invention to provide for a process where the conversion of animal fats to a gas oil fuel product, complies with environmental regulations.

According to the present invention, there is provided a process including the steps of:

heating the animal fats to a cracking temperature,

thermally cracking the animal fats in a cracking vessel to a mixture of lighter molecular weight compounds,

separating the lighter molecular weight compounds into a small fraction of volatile light ends and a second mixture of gas oil fuel in a distillation column

collecting the second mixture of gas oil fuel by means of a condenser.

Preferably, a first volume of liquid is extracted from the cracking vessel at a first level, heated to above the cracking temperature while being kept at a sufficiently high pressure to remain in the fluid state, and injected back into the cracking vessel beneath the surface level of the liquid in the cracking vessel. The first volume of extracted liquid is preferably heated to approximately 335 – 400 deg C.

The first volume of extracted liquid may be extracted from the cracking vessel from a first level and re-introduced to the cracking vessel at a second level higher than the first level.

A second volume of liquid may be extracted liquid from the cracking vessel from a level higher than the first level at which the first volume of liquid is extracted.

It has been found that animal fats can be cracked under low temperature, low severity conditions to yield a gas oil. This process occurs at

temperatures that permit the continuous flow processing of animal fats into a gas oil fuel without coking or fouling of the cracking apparatus.

The thermal cracking process uses low temperature cracking temperatures (in the range 335 – 400 deg.C. at ambient pressure to generate a column distilled fraction of gas oil mixed with light ends. The light ends being flashed off to produce a high quality gas oil having characteristics similar to that of a diesel fuel.

Figure 1 is a schematic of the process and apparatus.

The animal fat feedstock is stored in a holding tank 10. The process may be utilised for animal fats such as tallow, and similar animal-by-product fats and greases into a gas oil fuel. The feedstock is pre-heated by a heat exchanger 35 whilst still in the holding tank 10.

The feedstock is pumped from the holding tank 10 by a pump P-2. On exiting the holding tank 10, the feedstock is further heated to a selected temperature by series of heat exchangers H-2, H-3, that also serve to cool the finished product stream at various points in the process before it reaches the finished product tank 80. The arrangement of these heat exchangers is described in greater detail below. By exchanging and conserving heat in this way, the overall energy requirements of the system are greatly reduced.

The pump P-2 operates at a variable speed to pump the feedstock to the heat recovery device (HRD) 20 at a rate that equals the volume of feedstock being converted to a fuel product during the process. In this manner, the process is maintained in continuous equilibrium.

A heating device 30, comprising a thermal oxidiser, is provided with fuel and during its normal operation generates heat by the oxidation of the fuel. The heat generated is supplied to the HRD 20, which is close coupled to the thermal oxidiser.

The feedstock passes from the HRD 20 to a reaction and distillation assembly 10 comprising a cracking vessel and still pot 11 and a distillation column 12. The temperature of the liquid in the cracking vessel 11 is in the region of approximately 335 – 400 deg.C., and is at approximately ambient pressure.

The exhaust gases from the HRD 20 and heating device 30 pass through a heat exchanger H-1, and pump P-1 feeds the heated fluid to the holding tank heat exchanger 35.

The process is monitored and controlled automatically by a computer driven software program and receives signals from a series of electronic sensors located at various points in the process. The program then controls flow, temperature and other process parameters via electro-mechanically operated control valves and other devices.

The process control system has the ability to accurately maintain the process temperature at pre-set limits. The cracking temperature is maintained by the HRD 20 and heating device 30. A volume of the liquor is extracted from the cracking vessel by a pump P-3, typically drawn from the lower levels of the cracking vessel cracking vessel where the heavier, less pure components on the feedstock will reside. The extracted liquid is circulated under pressure (typically about 1 bar) through the heat recovery unit which heats the volume of liquor to a temperature above its normal

cracking temperature (up to about 420 deg C). Being under pressure, the volume of liquor remains in a fluid state until it is returned to the cracking vessel 11 via a pressure reducing device 40 at a point beneath the surface level of the liquor already in the cracking vessel 11. At this point the heated volume of liquor rapidly depressurises and vaporises, causing not only the cracking of the extracted heavy-fraction product but also imparting heat and promoting rapid and efficient cracking of light fraction product at the upper levels of the cracking vessel, and causing vaporisation of larger volumes of liquor in the cracking vessel.

The intention is to maintain the cracking temperature at the lowest temperature that will allow the process to operate continuously whilst allowing only a small percentage of light ends to be produced relative to the gas oil fuel product. This also has the effect of avoiding fouling or coking of the cracking vessel and associated process systems.

Under these mild process conditions, cracked products which constitute a gas oil fuel product can be economically obtained.

The distillation column 12 mounted above the cracking vessel 11 is an insulated cylinder filled with industry standard packing material. The column is designed to have a height and circumference calculated to efficiently allow that volume of vapours given off from the cracking vessel to achieve the required temperature reduction gradient.

With accurate temperature control, the lower molecular weight material fractions that have a boiling point above that of the selected cracking temperature leave the top of the column 12 as vapours comprising various light ends and volatile compounds. These gases pass through a condenser

15 where the temperature is reduced sufficiently to allow most of the gases to condense into a liquid and then be collected in a flash vessel 19. The condenser includes heat exchanger H-2, which, as previously described, heats the feedstock on leaving the holding tank 10.

The flash vessel 19 is fitted with electric heaters that are used to control the temperature in the flash vessel so that any residual water vapour, light ends and other unwanted compounds may be selectively flashed off, resulting in the flash point of the liquid gas oil being reduced to a specified level.

The gaseous light ends can be recirculated to the inlet of the thermal oxidiser 30 as fuel for the continuing oxidisation process. Alternatively (or additionally) the light ends may be passed to another condenser where they are allowed to collect as a liquid and are then passed to a holding tank to be used as a liquid fuel. Any unwanted compounds are also recirculated to the inlet of the thermal oxidiser where they are burned to destruction.

The liquid product remaining in the flash vessel 19 is transferred to the reflux product vessel 50 from where a proportional volume of the liquid is removed by a pump P-4 and injected into the distillation column 12 as reflux, where it is used to assist in controlling the temperature gradient in the column 12. The pump P-4 is controlled automatically so that the flow rate of the reflux accurately maintains the contact ratio between vapours passing through the column 12 and reflux. The reflux is injected into the column 12 at a point below the top of the column where a horizontal plate distributes the reflux evenly within the column to ensure that contact between vapours and reflux is maximised.

Liquid product remaining in the reflux product vessel 50 is transferred through heat exchanger H-2 to a finished product holding tank 80. The heat exchanger H-2, as previously described, heats the feedstock immediately as it leaves the holding tank 10.

Of course, the particular temperatures and pressures chosen to apply to the extracted liquor will depend upon the grade and purity of tallow which is used as a feedstock.

Referring to figure 2, lighter product may additionally be extracted by pump P-5 through an additional draw-off line from the cracking vessel and passed through the HRD 20 before being returned to the cracking vessel. This lighter product is passed through the HRD 20 at a higher velocity than the heavier, less pure product extracted from the lower levels of the cracking vessel, allowing the liquor temperature to be controlled to a temperature at approximately 350 deg C, thereby avoiding overheating the lighter fractions and avoid fouling the HRD 20.

Claims

1. According to the present invention, there is provided a process for converting animal fats into gas oil fuel including the steps of:

heating the animal fats to a cracking temperature,

thermally cracking the animal fats in a cracking vessel to a mixture of lighter molecular weight compounds,

separating the lighter molecular weight compounds into a small fraction of volatile light ends and a second mixture of gas oil fuel in a distillation column

collecting the second mixture of gas oil fuel by means of a condenser.

2. A process according to claim 1 wherein a first volume of liquid is extracted from the cracking vessel at a first level, heated to above the cracking temperature while being kept at a sufficiently high pressure to remain in the fluid state, and injected back into the cracking vessel beneath the surface level of the liquid in the cracking vessel.

3. A process according to claim 2 wherein the first volume of extracted liquid is heated to approximately 335 – 400 deg C.

4. A process according to either claim 2 or 3 wherein the first volume of extracted liquid is extracted from the cracking vessel from a first level and re-introduced to the cracking vessel at a second level higher than the first level.

5. A process according to any of claims 2 to 4 wherein a second volume of liquid is extracted liquid from the cracking vessel from a level higher than the first level at which the first volume of liquid is extracted.

6. A process according to any previous claim wherein the animal fat is fed from a storage tank to a heating device prior to being fed into the cracking vessel.

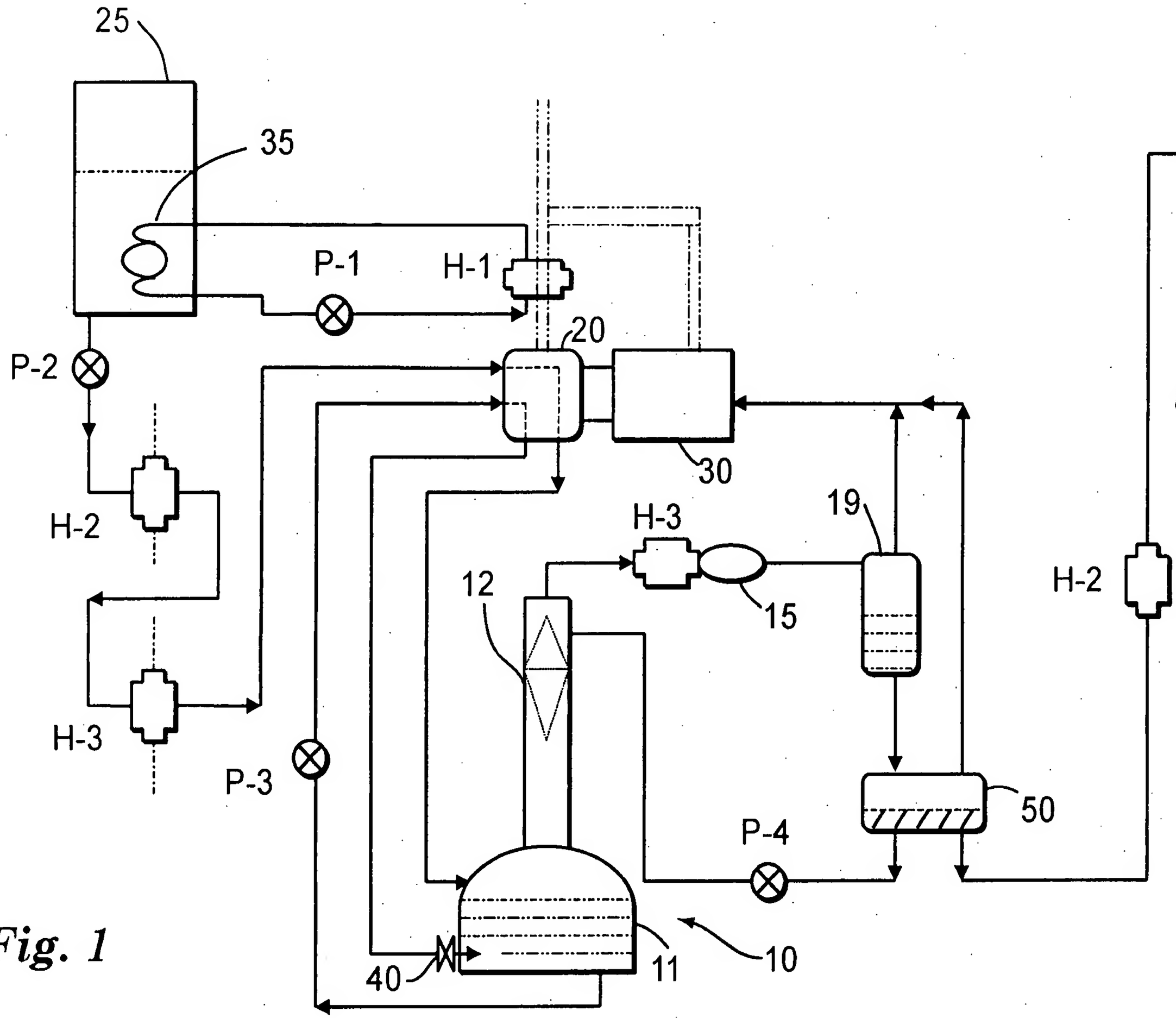

Fig. 1

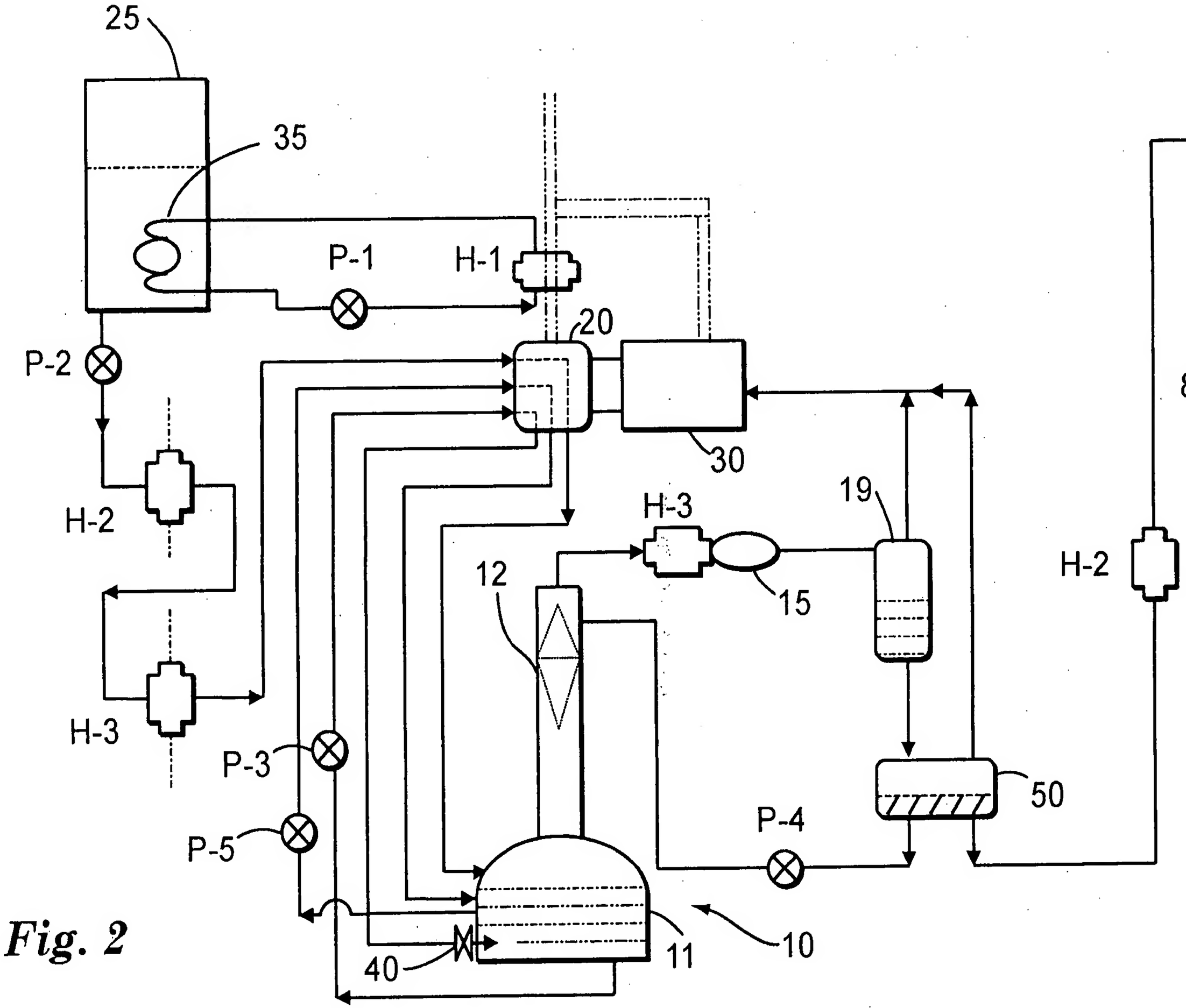

Fig. 2